Abstract: An air-bag (1) to be installed in a motor vehicle to protect an occupant (3) in the event of an accident situation. The air-bag (1) is provided with a vent arrangement which is normally in an open condition. The air-bag (1) is configured so that the vent arrangement (4) remains in the open condition when an occupant (3) is positioned close to the air-bag (1) during the initial stages of inflation of the air-bag (1) to minimise the chances of the air-bag (1) exerting a force on the occupant (3) which might injure the occupant (3). The vent arrangement (4) is configured to close in the event that the air-bag (1) is inflated to protect an occupant who is not sitting close to the air-bag (1) during the initial stages of inflation. The closure of the vent arrangement (4) minimises the possibility of the air-bag (1) deflating too rapidly so as to minimise the chance of the occupant (3) moving through the space occupied by the air-bag (1) and striking part of the vehicle on the other size of the air-bag (1), potentially facing injury.
An Air-bag

Description of Invention

THE PRESENT INVENTION relates to an air-bag, and more particularly relates to an air-bag to be installed in a motor vehicle to protect an occupant of the vehicle in the event that an accident situation occurs.

A front air-bag is often mounted within the steering wheel or dashboard of a vehicle so that the air-bag can be inflated in front of an occupant of the vehicle to protect the occupant in the event that an accident situation occurs. It is important that the air-bag not only provides adequate protection for the occupant during the accident situation but also that the air-bag inflates in a correct manner so as to minimise the chances of the air-bag itself injuring the occupant. The position of the occupant in the vehicle relative to the air-bag during the initial stages of inflation of the air-bag is a factor which affects the required manner in which the air-bag should be inflated so as to minimise injury to the occupant.

If the head or torso of an occupant is close to the air-bag during the initial stages of inflation of the air-bag, the air-bag may exert a large force on the head or torso of the occupant and injure the occupant, unless the inflation properties of the air-bag have been adapted so that the air-bag inflates in a correct manner for such a situation. The head or torso of an occupant may be positioned close to the air-bag during the initial stages of inflation of the air-bag if the occupant is sitting out of position, for instance the occupant is leaning forwardly, or if the occupant is a small occupant, for instance a five percentile female, who has moved the seat in the vehicle to a frontmost position so as to be able to reach pedals in the vehicle.
It has been proposed previously to provide an air-bag with a vent so that gas is vented from the air-bag during the initial stages of inflation of the air-bag. The venting of gas from the air-bag reduces the pressure of gas within the air-bag and hence reduces the force which the air-bag exerts on a closely positioned or out of position occupant. The parameters of the vent are selected so that gas is vented from the air-bag to the effect that the air-bag only exerts a low force on the head or torso of a closely positioned or out of position occupant so as to minimise the chances of the force exerted on the occupant injuring the occupant.

Whilst providing an air-bag with a vent as described above can help to minimise the chances of the air-bag injuring a closely positioned or out of position occupant, the inclusion of a vent in the air-bag may result in a reduction in the level in protection which the air-bag offers to an occupant who is positioned far from the air-bag during the initial stages of inflation of the air-bag. An occupant may be positioned far from the air-bag if the occupant is, for instance, a large occupant such as a 50 percentile male who is sitting uprightly on a seat which has been positioned at its rearmost position.

A large occupant will exert a large force on an inflated air-bag as the occupant is moved by forces arising during an accident situation. The inflated air-bag will deflate as the large occupant moves against the air-bag so as to provide a cushioning effect to protect the occupant. If the air-bag is provided with a vent, there is a possibility that when a large occupant moves against the inflated air-bag gas will be vented very rapidly from the air-bag, causing the air-bag to deflate too quickly. In some cases the air-bag may deflate to such an extent that the head or torso of the occupant moves right through the space initially occupied by the inflated air-bag to strike part of the vehicle on the other side of the air-bag, potentially seriously injuring the occupant.

The present invention seeks to provide an improved air-bag.
According to the present invention, there is provided an air-bag to be installed in a motor vehicle, the air-bag being provided with a vent arrangement which comprises a vent aperture for venting gas from within the air-bag and a cover element, the cover element being held in an initial position by a releasable connection but moveable, upon release of the releasable connection, to a covering position in which part of the cover element at least partially covers the vent aperture, wherein one end of an elongate release member is initially in engagement with the releasable connection and the other end of the release member is attached to a predetermined point on the interior of the air-bag, the length of the release member being selected so that when the air-bag inflates and the predetermined point on the air-bag interior moves to at least a predetermined distance from the releasable connection, the release member is pulled out of engagement with the releasable connection to release the connection and allow the cover element to move to the covering position to close the vent at least partly.

In one embodiment the vent arrangement further comprises an elastically deformable membrane which has the vent aperture formed therethrough, the membrane being mounted to the air-bag so as to close substantially a mounting aperture formed in the air-bag.

Preferably the elastically deformable membrane is configured to rupture if the pressure of gas within the air-bag exceeds a predetermined level.

Conveniently the cover element is an elongate strap, one end of the strap being connected to the air-bag at a first point on one side of the mounting aperture and the other end of the strap being connected to the air-bag at a second point on another side of the mounting aperture so that the strap extends at least partially across the mounting aperture, the strap incorporating a secondary vent aperture which, when the cover element is in the initial
position, is substantially aligned with the vent aperture in the membrane so that the vent is open to permit gas to be vented from within the air-bag.

Advantageously the length of the strap is greater than the distance between the first and second points on the respective sides of the mounting aperture, a part of the strap being formed into a loop which, when the strap is in the initial position, is laid flat against the air-bag interior on one side of one of the points, a part of the loop being connected by the releasable connection to the air-bag interior to hold the strap in the initial position.

Preferably the releasable connection comprises at least one retainer loop attached to the cover element, and a plurality of fixing loops attached to the air-bag, the or each retainer loop and each of the fixing loops defining respective apertures which, when the cover element is in the initial position, are aligned substantially with one another, part of the release member extending through the apertures to retain the or each retainer loop in position relative to the fixing loops to hold the cover element in the initial position.

Conveniently the length of the release member is selected so that a predetermined length of the release member protrudes from one side of the retainer and fixing loops, the releasable connection being released when the predetermined length of the release member is pulled out from the apertures in the or each retainer loop and each fixing loop.

Advantageously the releasable connection comprises breakable stitching between part of the cover element and part of the air-bag, the release member being attached to the stitching and the stitching being breakable when the release member is pulled, so that the releasable connection is released to allow the cover element to move to the covering position.
In another embodiment the cover element is a sheet of flexible material having at least one edge, the at least one edge being attached to part of the air-bag, with the sheet being held in the initial position by a retainer strap which forms part of the releasable connection.

Preferably part of the sheet is folded to form a bundle when the sheet is in the initial position, at least part of the bundle being surrounded by the retainer strap to hold the sheet in the initial position, the retainer strap being held in place by the releasable connection, and the release member engaging the releasable connection so that the releasable connection is broken when the release member is pulled so that the retainer strap is released to allow the sheet to move to the covering position.

Conveniently part of the retainer strap is stitched with breakable stitching to hold the retainer strap in position around the bundle, the breakable stitching being configured to break when the release member is pulled so that the retainer strap is released to allow the sheet to move to the covering position.

Advantageously tension in material forming the air-bag pulls the sheet from the initial position to the covering position as the air-bag inflates.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a diagrammatic view of a safety arrangement which incorporates an air-bag in accordance with a preferred embodiment of the invention,

FIGURE 2 is a diagrammatic perspective view of part of an inner surface of the air-bag of Figure 1, showing a vent in a normal, open, condition,
FIGURE 3 is a diagrammatic sectional view of the part of the air-bag shown in Figure 2,

FIGURE 4 is a diagrammatic perspective view of a releasable connection associated with the vent shown in Figure 2,

FIGURE 5 is a view of part of the air-bag of Figure 2 during an accident situation during which a small closely positioned occupant moves against the air-bag,

FIGURE 6 is a diagrammatic sectional view of the part of the air-bag shown in Figure 5,

FIGURE 7 is a view of the part of the air-bag of Figure 2 during an accident situation during which a large occupant, who is not positioned close to the air-bag during the initial stages of inflation, moves against the air-bag,

FIGURE 8 is a diagrammatic perspective view of the outer surface of the part of the air-bag of Figure 7,

FIGURE 9 is a diagrammatic sectional view of the part of the air-bag shown in Figure 8,

FIGURE 10 is a view corresponding to Figure 2 of the part of the air-bag during an overpressure situation,

FIGURE 11 is a diagrammatic sectional view of the part of the air-bag shown in Figure 10,
FIGURE 12 is a diagrammatic perspective view of a releasable connection in accordance with a further embodiment of the invention,

FIGURE 13 is a diagrammatic perspective view of part of an air-bag in accordance with a still further embodiment of the invention, showing a vent in an open condition, and

FIGURE 14 is a view corresponding to Figure 13, showing the vent in the process of closing.

Referring initially to Figure 1, an air-bag 1 in accordance with a preferred embodiment of the invention is a front air-bag which is normally folded within a housing which is mounted within a steering wheel 2 of a motor vehicle so that the air-bag 1 can be inflated in front of an occupant 3 to protect the occupant 3, as seen in Figure 1. The air-bag 1 is provided with a vent arrangement 4 which will be described in detail below.

The vent arrangement 4 incorporates an elongate release member in the form of a release cable 5. In this preferred embodiment the release cable 5 is a flexible fabric tether which is 10 mm wide and 2 mm thick, but it is to be understood that in other embodiments the elongate release member may be of a different material such as plastic or metal and have different dimensions. One end of the release cable 5 is attached to a point 6 on an inner surface of the air-bag 1 which, upon inflation of the air-bag 1, contacts the head or torso of the occupant 3. The other end of the release cable 5 is a free end which is initially in engagement with a releasable connection 7 which also forms part of the vent arrangement 4, and which will be described in detail below with reference to Figures 2 to 4 of the accompanying drawings.

Referring now to Figures 2 and 3 of the accompanying drawings, the vent arrangement 4 can be seen in an initial condition. The vent arrangement 4
comprises a substantially circular mounting aperture 8 which is formed through
the part of the air-bag 1. A substantially circular elastically deformable
membrane 9 extends across the mounting aperture 8 to close substantially the
mounting aperture 8. The outer edge of the membrane 9 is stitched to the air-
bag 1 around the edge of the mounting aperture 8 so that a substantially gas-
tight seal is formed between the membrane 9 and the material of the air-bag 1.
In other embodiments the membrane 9 may be attached to the air-bag 1 by
any other means, such as by adhesive which may or may not provide a
substantially gas-tight seal.

The membrane 9 has a substantially circular vent aperture 10 formed
therethrough at a position which is generally at the centre of the circular shape
defined by the membrane 9 when the membrane extends across the mounting
aperture 8 of the air-bag 1.

The vent arrangement 4 further comprises a cover element in the form of an
elongate strap 11 which, in this preferred embodiment, is of the same material
as the material of the air-bag 1. However, in other embodiments the strap 11
may be of any other flexible material which may be different to the material of
the air-bag 1. The strap 11 comprises three sections which are connected end
to end. A first section 12, which is the narrowest section of the strap 11, is
formed from an elongate rectangular section of material. One end of the first
section 12 is connected to the interior of the air-bag 1 by stitching at a first
point 13 on one side of the mounting aperture 8. A secondary vent aperture
14 is formed through the first section 12 of the strap 11 at a position such that
when the strap 11 is in the initial position, as seen in Figure 2, the secondary
vent aperture 14 is substantially aligned with the vent aperture 10 in the
membrane 9 so that the vent is open to allow gas to be vented through the
vent apertures 10, 14.
The end of the first section 12 of the strap 11 remote from the end stitched to
the air-bag 1 is formed integrally with a second section 15 which is of
trapezoidal shape. The first section 12 joins the second portion 15 at the
narrower end of the trapezoidal second section 15, with the width of the
second section 15 increasing over the length of the second section 15 to a
wider end of the trapezoidal shape where the second section 15 is formed
integrally with a third section 16.

The third section 16 of the strap 11 is approximately twice the length of the first
section 12, and is approximately twice as wide as the first section 12. However, it is to be appreciated that in other embodiments the dimensions of
the third section 16 may differ, particularly if the third section 16 is of a different
material to the material of the air-bag.

The end of the third section 16, remote from where the third section 16 joins
the second section 15, is connected by stitching to the interior of the air-bag 1
at a second point 17 which is close to the mounting aperture 8 but
diametrically opposite the first point 13 where the other end of the strap 11 is
connected to the air-bag 1. The overall length of the strap 11 is greater than
the distance between the first and second points 13,17 where the ends of the
strap are connected to the air-bag 1. When the strap 11 is in the initial position
the third section 16 of the strap 11 is folded in half so as to form a loop 18
having a first portion 19 and a second portion 20. The first portion 20 of the
loop 18 is folded back and laid flat against the air-bag 1 so as to extend away
from the second point 17 in a direction which is substantially aligned with an
axis passing through the first and second points 13,17. The second portion 20
of the loop 18 is laid flat over the first portion 19 so that the loop 18 is
substantially flat against the interior surface of the air-bag 1, with a crease 21
being formed at the end of the loop 18 between the first and second
portions 19,20.
Referring now to Figure 4, a retainer loop 22 is attached to the crease 21 of the strap 11 to extend outwardly from the end of the loop 18. The retainer loop 22 forms part of the releasable connection 7 to connect the strap 11 releasably to the air-bag 1 and to hold the strap 11 in the initial position, flat against the air-bag 1. The retainer loop 22 is positioned between a pair of fixing loops 23,24 which are fixed to the interior of the air-bag 1 to extend upwardly on each side of the retainer loop 22 of the strap 11. The fixing loops 23,24 and the retainer loop 22 each define respective apertures therethrough, which are aligned with one another when the strap 11 is in the initial position with the retainer loop 22 between the pair of fixing loops 23,24.

When the strap 11 is in the initial position, the free end of the release cable 5 extends through the apertures in the retainer loop 22 and the fixing loops 23,24 of the releasable connection 7. The release cable 5 acts as a locking member which prevents the retainer loop 22 of the strap 11 being moved from between the pair of fixing loops 23,24 on the air-bag 1 so that the strap 11 is connected to the air-bag 1 and held in the initial position. As will become apparent from the description below, the release cable 5 may be pulled out of engagement with the retainer loop 22 and the fixing loops 23,24 so as to release the releasable connection 7 and allow the strap 11 to move from the initial position.

It is to be appreciated that in other embodiments of the invention, the strap 11 may be provided with more than one retainer loop, and the air-bag 1 may be provided with a larger or smaller number of fixing loops. In other embodiments of the invention the or each retainer loop is formed integrally with the strap 11 or is formed by part of the strap 11 which is provided with at least one aperture. Whilst in the preferred embodiments the fixing loop 23,24 are stitched to the air-bag 1, in other embodiments the or each fixing loop is attached by another means to the air-bag 1, for instance by adhesive, or by the or each fixing loop being formed integrally with the air-bag 1.
It will become clear from the description below that the length of the release cable 5 is selected so as to define a predetermined length L by which the free end of the release cable 5 extends out from one side of the retainer loops 23, 24.

The operation of the air-bag 1 will now be described for when the air-bag 1 is inflated in four different situations.

In a first situation an occupant 3 is out of position and leaning forwardly so that the head or torso of the occupant 3 is close to the air-bag 1 during the initial stages of inflation of the air-bag 1 during an accident situation. The vent arrangement 4 is initially in an open condition, with the strap 11 held in place by the releasable connection 7 and the vent aperture 10 aligned with the secondary vent aperture 14 to allow gas to be vented from the air-bag 1. As the air-bag 1 inflates the front of the air-bag 1 moves towards the occupant 3 and the end of the release cable 5 which is attached to the point 6 at the front of the air-bag 1 is pulled away from the releasable connection 7.

Since the occupant 3 is positioned close to the air-bag 1 during the initial stages of inflation of the air-bag 1 the point 6 on the air-bag 1 where the release cable 5 is attached contacts the head or torso of the occupant 3 before the release cable 5 is pulled taut. Consequently, the free end of the release cable 5 remains threaded through the fixing loops 23, 24 and the retainer loop 22 and remains in engagement with the releasable connection 7 so the strap 11 remains held in the initial position with the secondary vent aperture 14 aligned with the vent aperture 10, as seen in Figure 2. The vent arrangement 4 thus remains in an open condition to allow gas to be vented from the air-bag 1 to reduce the pressure of gas within the air-bag 1 so as to minimise the chances of the air-bag 1 exerting a force on the out of position occupant 3 which might otherwise injure the occupant 3.
In a second situation, the occupant 3 is a small occupant, such as a five percentile female, who is sitting in a normal upright position but is positioned forwardly so as to be able to drive the vehicle. In this situation, despite the fact that the occupant 3 is not considered to be out of position, the head and torso of the occupant 3 are still close to the air-bag 1 during the initial stages of inflation of the air-bag 1. Consequently, when the air-bag 1 inflates, the front of the air-bag 1 contacts the head or torso of the occupant 3 before the point 6 on the front of the air-bag 1 has moved a sufficient distance from the vent arrangement 4 to pull the release cable 5 taut and move the free end of the release cable 5 out of engagement with the releasable connection 7. Therefore, in this situation the strap 11 is held in the initial position by the releasable connection 7 and the vent arrangement 4 remains in an open condition to minimise the chances of the air-bag 1 exerting a force on the occupant 3 which might injure the occupant 3.

Referring now to Figures 5 and 6, a closely positioned occupant 3 moves against the inflating air-bag 1 which raises the pressure of the gas within the air-bag 1. The pressure of gas within the air-bag 1 exerts a force on the membrane 9 of the vent arrangement 4 in a direction indicated generally by arrows 25. The force on the membrane 9 from within the air-bag 1 deforms the membrane 9 outwardly, as seen in Figure 5. The deformation of the membrane 9 allows gas to pass around the edges of the strap 11, as well as through the secondary vent aperture 14, with the gas being vented from the vent aperture 10 in the membrane 9 in the direction indicated generally by arrow 26. It should be noted that, in this situation, the strap 11 may not deform sufficiently to lie against the inner surface of the membrane 9, since the strap 11 is held in place by the releasable connection 7. As the membrane 9 deforms, the vent aperture 10 becomes enlarged so that gas can be vented at a higher rate as compared with the normal condition where the vent aperture 10 is not enlarged.
It is to be understood that when the occupant 3 is positioned close to the air-bag 1 during the initial stages of inflation of the air-bag 1 the vent arrangement 4 remains in an open condition to allow gas to be vented from the air-bag 1. The venting of gas from the air-bag 1 during the initial stages of inflation reduces the pressure of gas within the air-bag 1 so as to minimise the chances of the air-bag exerting a force on the closely positioned occupant 3 which might injure the occupant 3.

In a third situation, the occupant 3 is a large occupant, for instance a 50 percentile male, who is not positioned close to the air-bag 1 during the initial stages of inflation of the air-bag 1. In this situation the distance between the air-bag 1 and the occupant 3 is large enough to allow the air-bag 1 to inflate fully before contacting the occupant 3. As the air-bag inflates, the point 6 on the front of the air-bag 1 at which the release cable 5 is connected moves a sufficient distance from the vent arrangement 4 so that the release cable 5 is pulled taut and the free end of the release cable 5 is pulled out of engagement which the releasable connection 7.

Referring now to Figures 7 to 9, when the free end of the release cable 5 is pulled out of engagement with the releasable connection 7, the loop 18 of the strap 11 is released. As the occupant 3 moves against the inflated air-bag 1 the occupant 3 exerts a large force on the air-bag 1 which raises the pressure of the gas within the air-bag 1 which in turn exerts a force on the membrane 9 to deform the membrane 9 outwardly, as seen in Figure 7. In this situation, since the strap 11 has been released, the strap 11 moves to conform with the inner surface of the deformed membrane 9, with the thicker third section 16 of the strap 11 covering the vent aperture 10 in the membrane 9, as seen in Figures 8 and 9. The vent arrangement 4 is thus closed so that gas is not vented from the air-bag 1. The pressure of the gas within the air-bag 1 is thus maintained so as to minimise the possibility of the large occupant moving
through the space occupied by the inflated air-bag 1 to strike part of the vehicle on the other side of the air-bag 1.

In a fourth situation, an occupant 3 is not positioned close to the air-bag 1 during the initial stages of inflation of the air-bag 1, and consequently the air-bag 1 is able to inflate sufficiently so that the release cable 5 is pulled out of engagement with the releasable connection and the strap 11 is allowed to move to cover the vent aperture 10. However, in this fourth situation the occupant 3 is an extremely large occupant, and/or the vehicle is involved in a very high severity accident, which results in a very large force being exerted on the air-bag 1 as the occupant moves against the air-bag 1. The very large force exerted on the air-bag 1 results in an overpressure situation whereby the pressure of gas within the air-bag 1 rises above a predetermined level and venting of gas is required so as to minimise the chances of the occupant 3 bouncing back off the air-bag 1 and the potentially facing injury.

Referring now to Figures 10 and 11, in an overpressure situation the membrane 9 ruptures so that the mounting aperture 8 in the air-bag 1 is no longer substantially closed, and thus the mounting aperture 8 itself forms a large vent aperture from which gas can be vented rapidly from the air-bag 1 to minimise the chances of injury to the occupant as a result of the overpressure situation.

It is to be appreciated that the inflation characteristics of the air-bag 1 of embodiments of the invention are adaptable automatically so that the air-bag 1 inflates and deflates in an appropriate manner for the position of an occupant relative to the air-bag 1.

Whilst in the preferred embodiments described above the releasable connection 7 is in the form of fixing loops 23,24 and a retainer loop 22, with the free end of the release cable 5 extending through the loops 22-24, in a further
embodiment the releasable connection 7 is formed by stitching 27 as seen in Figure 12. In this further embodiment, the stitching 27 stitches the end of the loop 18 to the air-bag 1 so as to hold the strap 11 in the initial position. The stitching 27 also stitches the free end of the release cable 5 to the strap 11. The thread forming the stitching 27 is less robust than the material forming the release cable 5. In the event that the release cable 5 is tensioned by inflation of the air-bag 1 the free end of the release cable 5 pulls the strap 11 with sufficient force to break the stitching 27 and hence release the connection between the strap 11 and the air-bag 1 to permit the strap 11 to move from the initial position.

Referring now to Figure 13, in a still further embodiment of the invention, the strap 11 is replaced by a cover element in the form of a cover sheet 28. The cover sheet 28 is of generally rectangular shape and is of the same material as the material of the air-bag 1. During the manufacture of the air-bag of this still further embodiment the cover sheet 28 is laid over a vent aperture 29 which is formed through a part of the air-bag 1. The cover sheet 28 is then attached to the air-bag 1 by stitching around three of its edges 30-32. One of the edges of the cover sheet 28 is left unstitched so as to leave a free edge 33 of the cover sheet 28. The free edge 33 of the cover sheet 28 is moved so as to uncover the vent aperture 29, with material forming the sheet 28 being gathered in a bundle 34 on one side of the vent aperture 29.

The bundle of material 34 is held together by a retainer strap in the form of roll of material 35 which may be fixed to the air-bag 1 and which extends around the bundle 34. The roll of material 35 is stitched by stitching 36 so that the roll of material 35 holds the bundle 34 together with the vent aperture 29 being uncovered and in an initial condition. The stitching 36 forms a releasable connection which, together with the roll of material 35, holds the cover sheet 28 in an initial position, with the vent aperture 29 being uncovered. A release
cable 37 is attached to the stitching 36, and is preferably attached to each loop thereof.

In the event that an accident situation occurs and the air-bag 1 is inflated, and tension is applied to the release cable 37 as a result of the positioning of an occupant relative to the air-bag 1, the tension in the release cable 37 pulls the stitching 36 apart to release the bundle 34, as seen in Figure 14. Once the bundle has been released, tension in the material of the air-bag 1 as the air-bag 1 inflates pulls the ends of the cover sheet 28 apart from one another, as indicated by the arrows 38. The tension in the material of the air-bag 1 pulls the cover sheet 28 over the vent aperture 29 to close the vent aperture 29.

When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.
Claims

1. An air-bag (1) to be installed in a motor vehicle, the air-bag (1) being provided with a vent arrangement (4) which comprises a vent aperture (10) for venting gas from within the air-bag (1) and a cover element (11), the cover element being held in an initial position by a releasable connection (7) but moveable, upon release of the releasable connection, to a covering position in which part of the cover element (11) at least partially covers the vent aperture (10), characterised in that one end of an elongate release member (5) is initially in engagement with the releasable connection (7) and the other end of the release member (5) is attached to a predetermined point (6) on the interior of the air-bag (1), the length of the release member (5) being selected so that when the air-bag (1) inflates and the predetermined point (6) on the air-bag interior moves to at least a predetermined distance from the releasable connection (7), the release member (5) is pulled out of engagement with the releasable connection (7) to release the connection (7) and allow the cover element (11) to move to the covering position to close the vent (10) at least partly.

2. An air-bag according to claim 1, wherein the vent arrangement (4) further comprises an elastically deformable membrane (9) which has the vent aperture (10) formed therethrough, the membrane (9) being mounted to the air-bag (1) so as to close substantially a mounting aperture (8) formed in the air-bag (1).

3. An air-bag according to claim 2, wherein the elastically deformable membrane (9) is configured to rupture if the pressure of gas within the air-bag (1) exceeds a predetermined level.
4. An air-bag according to claim 2 or claim 3, wherein the cover element (11) is an elongate strap (11), one end of the strap being connected to the air-bag (1) at a first point (13) on one side of the mounting aperture (8) and the other end of the strap (11) being connected to the air-bag (1) at a second point (17) on another side of the mounting aperture (8) so that the strap (11) extends at least partially across the mounting aperture (8), the strap (11) incorporating a secondary vent aperture (14) which, when the cover element (11) is in the initial position, is substantially aligned with the vent aperture (10) in the membrane (9) so that the vent (4) is open to permit gas to be vented from within the air-bag (1).

5. An air-bag according to claim 4, wherein the length of the strap (11) is greater than the distance between the first and second points (13,17) on the respective sides of the mounting aperture (8), a part of the strap (11) being formed into a loop (18) which, when the strap (11) is in the initial position, is laid flat against the air-bag interior (1) on one side of one of the points (13,17), a part of the loop (18) being connected by the releasable connection (7) to the air-bag interior (1) to hold the strap (11) in the initial position.

6. An air-bag according to any one of the preceding claims, wherein the releasable connection (7) comprises at least one retainer loop (22) attached to the cover element (11), and a plurality of fixing loops (23,24) attached to the air-bag (1), the or each retainer loop (22) and each of the fixing loops (23,24) defining respective apertures which, when the cover element (11) is in the initial position, are aligned substantially with one another, part of the release member (5) extending through the apertures to retain the or each retainer loop (22) in position relative to the fixing loops (23,24) to hold the cover element (11) in the initial position.

7. An air-bag according to claim 6, wherein the length of the release member (5) is selected so that a predetermined length (L) of the release
member (5) protrudes from one side of the retainer and fixing loops (22,23,24), the releasable connection (7) being released when the predetermined length (L) of the release member (5) is pulled out from the apertures in the or each retainer loop (22) and each fixing loop (23,24).

8. An air-bag according to any one of claims 1 to 5, wherein the releasable connection (7) comprises breakable stitching (27) between part of the cover element (11) and part of the air-bag (1), the release member (5) being attached to the stitching (27) and the stitching (27) being breakable when the release member (5) is pulled, so that the releasable connection (7) is released to allow the cover element (11) to move to the covering position.

9. An air-bag according to claim 1, wherein the cover element is a sheet (28) of flexible material having at least one edge (30-33), the at least one edge (30-33) being attached to part of the air-bag (1), with the sheet (28) being held in the initial position by a retainer strap (35) which forms part of the releasable connection (7).

10. An air-bag according to claim 9, wherein part of the sheet (28) is folded to form a bundle (34) when the sheet (28) is in the initial position, at least part of the bundle (34) being surrounded by the retainer strap (35) to hold the sheet (28) in the initial position, the retainer strap (35) being held in place by the releasable connection (7), and the release member (5) engaging the releasable connection (7) so that the releasable connection (7) is broken when the release member (5) is pulled so that the retainer strap (35) is released to allow the sheet (28) to move to the covering position.

11. An air-bag according to claim 10, wherein part of the retainer strap (35) is stitched with breakable stitching to hold the retainer strap (35) in position around the bundle (34), the breakable stitching being configured to break
when the release member (5) is pulled so that the retainer strap (35) is released to allow the sheet (28) to move to the covering position.

12. An air-bag according to any one of claims 9 to 11, wherein tension in material forming the air-bag (1) pulls the sheet (28) from the initial position to the covering position as the air-bag (1) inflates.
**A. CLASSIFICATION OF SUBJECT MATTER**

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**EPO-INTERNAL, WPI, DATA, PAJ**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<th>Category*</th>
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<th>Relevant to claim No.</th>
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Further documents are listed in the continuation of Box C.

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search: 16 April 2007

Date of mailing of the international search report: 26-04-2007

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Authorized officer

Hans Nordström/EK

Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (April 2007)
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International patent classification (IPC)

**B60R 21/239 (2006.01)**

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Paper copies can be ordered at a cost of 50 SEK per copy from PRV **IPterPat** (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.
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